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(54) Microphone unit

(57) A telephone handset includes an electrostatic microphone unit comprising an electret microphone (3) enclosed in a housing comprising a case (1) and cover (9). In order to reduce the response of the unit at frequencies greater than 3.5 KHz an acoustic filter is provided which includes a cavity (51) having apertures (45, 52) in opposed walls. The cavity is formed between a first member (4) having a cylindrical recess and a disc shaped plug member (5) which engages in the recess.

A moisture barrier comprising a melinex disc (7) is fixed by two annular foam members (6, 8) between the cover (9) and first member (4).

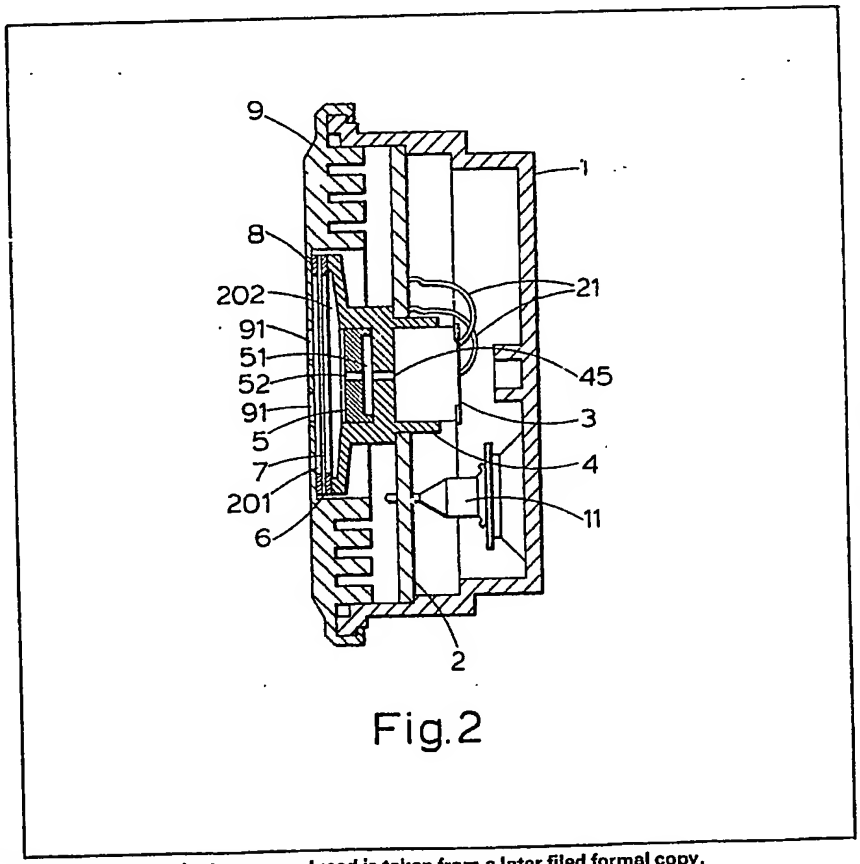

Fig.2

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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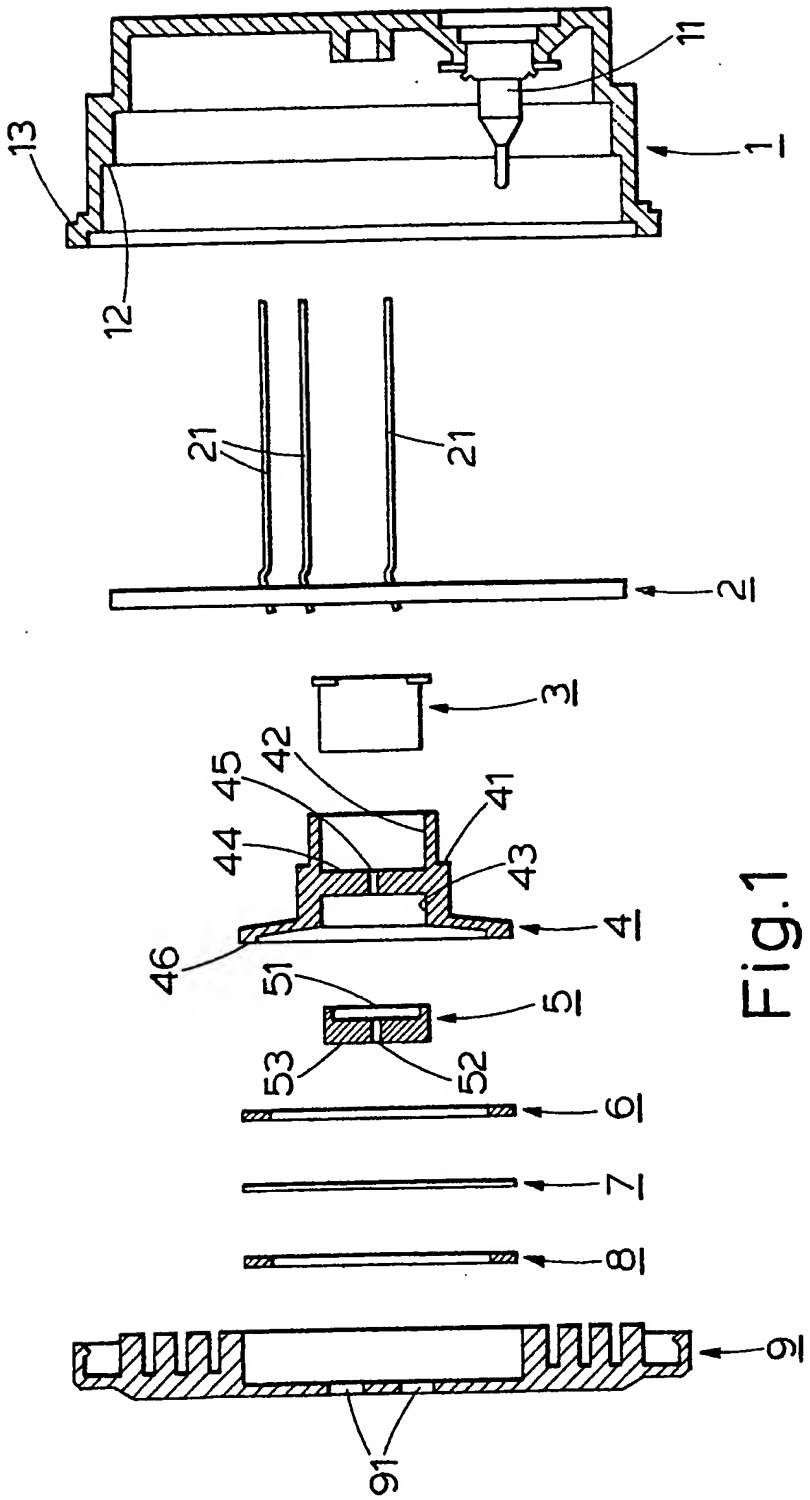

Fig.1

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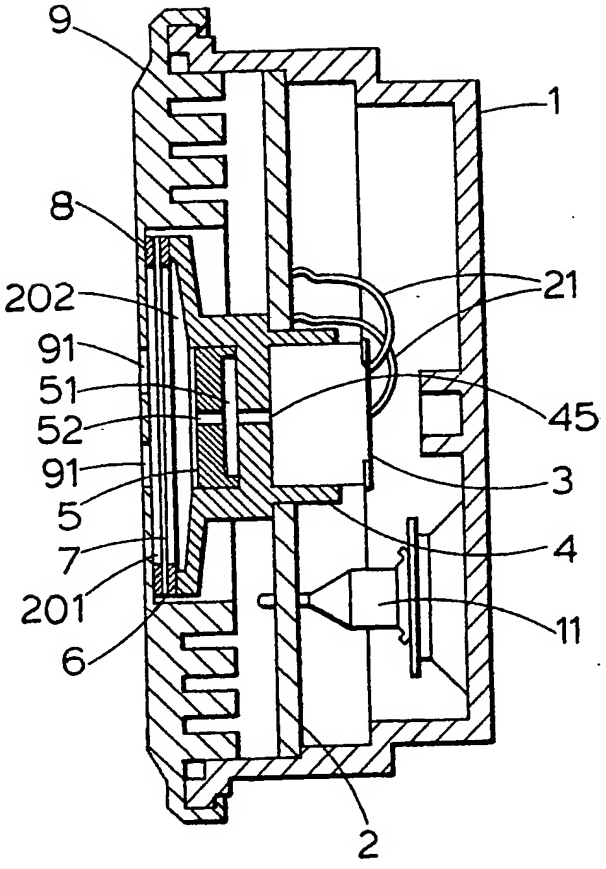

Fig.2

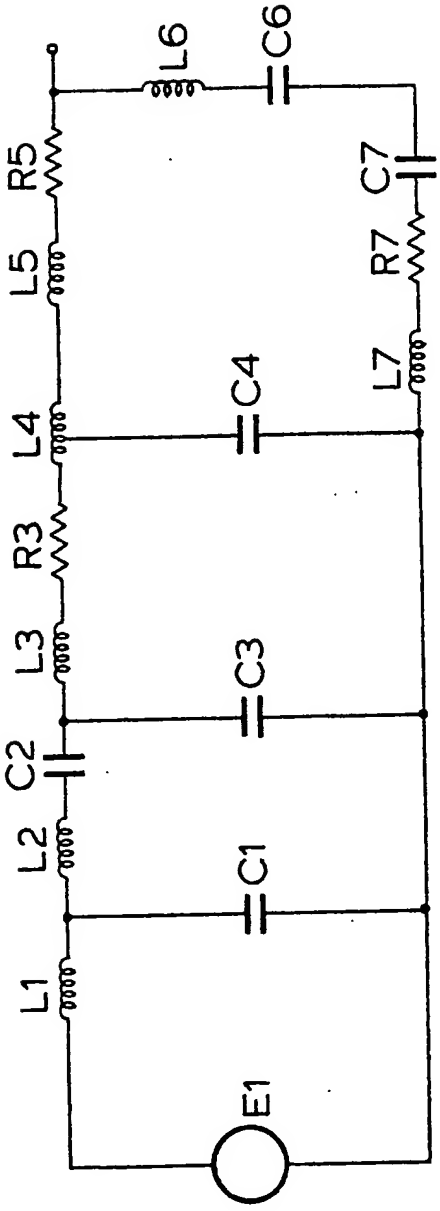

Fig.3

SPECIFICATION

Telephone handset

The invention relates to a telephone handset including an electrostatic microphone unit.

Traditionally a telephone handset has included a carbon microphone. Its advantages are high output and low impedance, robustness, cheapness and relative insensitivity to room noise. In the past these factors have outweighed the disadvantages of amplitude and frequency distortion, high intrinsic noise and changes in sensitivity with orientation, passage of time and feed current. The normal carbon microphone used in telephone handsets has an upper frequency limit not substantially in excess of 3500 Hz due to its diaphragm size and construction. This is advantageous in that it reduces the demands on the filters within the telephone system. An electrostatic microphone such as an electret microphone has a more linear output than the carbon microphone but has a lower electrical output signal and needs an amplifier to produce an adequate output signal. It may also have a frequency response which extends to 10 KHz or more. It is desirable to limit the frequency response to approximately the same range as that produced by the carbon microphone. It would be possible to include a filter in the amplifier to restrict the frequency range of the amplifier output. This, however, will increase the cost of the amplifier and may also make the amplifier more likely to become unstable.

It is an object of the invention to provide a telephone handset including an electrostatic microphone unit in which the frequency response of the microphone unit may be limited without the use of an electrical filter.

The invention provides a telephone handset including an electrostatic microphone unit in which the frequency response of the microphone unit is limited by the use of an acoustic filter which includes a cavity having two opposed walls wherein each wall has an aperture through which the acoustic signal passes from the source to the electrostatic microphone.

This enables the amplifier to be designed to have a relatively flat response between 3.5KHz and 10KHz thus simplifying the design and minimising the number of components needed and hence the cost. The combination of the two apertures and the cavity produces a double humped frequency response similar to that produced in the intermediate frequency amplifier of radio receiver by a double tuned transformer. The degree of coupling depends on the dimensions of the apertures and the cavity while the frequency at which the resonances, which cause the humps in the frequency response, occur depends on the ratio of the length to diameter of the apertures.

The cavity may be formed by a first member having a cylindrical recess and a second disc shaped plug member located within the cylindrical recess, the disc and the bottom of the recess forming the opposed walls.

This enables a significant portion of the acoustic filter to be formed by two plastics mouldings which engage one within the other.

The disc shaped member may have a recess in one face and be inserted so as to engage with the bottom of the cylindrical recess in the first member, the recess in the disc shaped member forming the cavity. This enables the dimensions of the cavity to be repeatable from unit to unit provided that the first member and disc shaped member are moulded to suitable tolerances.

A moisture barrier comprising a plastics film may be attached to the inside of a front cover of the microphone unit. This prevents moisture from the atmosphere or from the mouth of the user entering the microphone unit. For convenience of assembly the moisture barrier may be attached to the front cover by means of an annular plastics foam member having a contact adhesive on each side. The plastics foam being resilient provides some acoustic damping at the edges of the plastics film, which is acoustically bright, and hence reduces any reflections from the edges of the film.

The moisture barrier may be attached to the first member by a further annular plastics foam member having a contact adhesive on each side. Since the first member and the moisture barrier may form a closed cavity it is desirable to provide a means for equalising the pressure between the inside of the cavity and the outside. Such means may be provided by forming the or each plastics foam member from an open cell polyethylene foam.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which

Figure 1 is an exploded cross sectional elevation of a microphone unit for a telephone handset according to the invention.

Figure 2 is a cross-sectional elevation of a microphone unit assembled from the elements shown in Figure 1 and

Figure 3 is an equivalent electrical circuit of the acoustic filter formed by cavities within the microphone unit shown in Figure 2.

As shown in Figure 1 the microphone unit comprises a case 1, a printed circuit board 2 carrying an amplifier circuit, an electret microphone unit 3, a first member 4, a disc shaped plug member 5, a first annular foam member 6, a circular melinex diaphragm 7, a second annular foam member 8, and a cover 9.

The case 1 is circular in plane and is formed as a polypropylene injection moulding. The case 1 carries two terminals, one of which is shown at 11, and has a shoulder 12 against which the printed circuit board 2 locates.

The printed circuit board has a central circular aperture in which the first member 4 locates with a shoulder 41 abutting against the surface of the printed circuit board. The electret microphone 3 is located in a circular recess 42 in the member 4 and thus when assembled projects through the

printed circuit board 2 towards the base of the case 1. Three leads 21 which are attached to the printed circuit board 2 at one end are soldered to terminals on the electret microphone 3. The first member 4 has a further circular recess 43 aligned with the recess 42 and separated from it by a web 44 which is provided with a central aperture 45. The plug member 5 is a force fit in the recess 43 and has a circular recess 51 and a central aperture 52. The web 44 and plug 5 form opposed walls of a cavity consisting of the volume of the recess 51. In particular unit the apertures 45 and 52 were both 0.49 mm in diameter while the web 44 was 2.18 mm thick and the plug 5 had a total depth of 3.0 mm and the recess 51 a depth of 1 mm and a diameter of 8.5 mm.

The annular foam members 6 and 8 are formed from an open cell polyethylene plastics foam and are provided with a pressure sensitive adhesive on each face so that when the microphone unit is assembled the melinex diaphragm 7 is sandwiched between the foam members 6 and 8 which are in turn sandwiched between the cover 9 and a flange 46 on the first member 4. The cover 9 is formed by injection moulding, has a number of apertures 91 through which sound waves pass and snap fits over a shoulder 13 on the case 1.

Figure 2 shows the assembled microphone unit and as can be seen from this figure the path for sound waves to the electret microphone unit 3 is through a series of cavities and apertures. Apertures 91 in the cover 9 lead to a cavity 201 formed between the cover 9 and the melinex diaphragm 7. Sound pressure waves will cause the disc 7 to vibrate and thus transmit the pressure variations to a further cavity 202 formed between the diaphragm 7 the flange 46 on the first member 4 and an outer face 53 of the disc shaped member 5. These pressure variations are transmitted through the aperture 52 in the member 5 into the cavity 51 and through the aperture 45 to the electret microphone 3. This arrangement of cavities diaphragm and apertures forms an acoustic filter which is tuned to provide a response which falls rapidly above about 3.5KHz. This characteristic is useful in telephone communications as it reduces the requirements for further filtering of the audio signal to restrict it to the available bandwidth. The use of an open cell foam for the annular member 6 allows pressure equalisation between the cavity 202 and the atmosphere through the cell structure of the foam. By this means the provision of a separate pressure equalising channel is rendered unnecessary thus saving an additional manufacturing step.

Figure 3 shows an electrical analogue of the acoustic filter formed in the microphone unit described with reference to Figures 1 and 2 of the drawings. In Figure 3 EI represents the source of sound waves; LI the mass of the air in the apertures 91 in the front cover 9; CI the compliance of the air in the cavity 201 between the cover 9 and diaphragm 7; L2 the mass of air in cavity 202 formed between the diaphragm 7, the flange 46 on the first member 4 and the outer face 53 of the disc member 5; C2 the compliance of the air in cavity 202; L3 the mass of air in the aperture 51 of the disc member 5; R3 the resistance of the air in the aperture 52 of the disc member 5; L4 the effective mass of air in the cavity 52 formed between the member 5 and the member 4; C4 the compliance of the air in cavity 52; L5 the mass of air in the aperture 45 in the web 44 of the member 4; R5 the resistance of the air in the aperture 45; L6 the mass of air in front of the electret microphone diaphragm and of the electret microphone diaphragm; C6 the compliance of the air in front of the electret microphone diaphragm and of the electret microphone diaphragm; C7 the compliance of the air in the cavity behind the electret microphone diaphragm; R7 the resistance of the air in the cavity behind the electret microphone diaphragm; and L7 the mass of the air in the cavity behind the electret microphone diaphragm.

Various modifications may be made to the microphone unit described without departing from the invention. For example other types of electrostatic microphone such as a capacitor microphone may be used. A closed cell plastics foam may be used for the annular member 8 provided that some other means for pressure equalisation between the cavity 202 and the atmosphere is provided such as a channel cut through the foam. Although in the embodiment described the apertures 45 and 52 were of the same diameter this is not essential and it may be convenient in order to obtain certain characteristics to give the apertures different diameters.

CLAIMS

1. A telephone handset including an electrostatic microphone unit in which the frequency response of the microphone unit is limited by the use of an acoustic filter which includes a cavity having two opposed walls wherein each wall has an aperture through which the acoustic signal passes from the source to the electrostatic microphone.

2. A telephone handset as claimed in Claim 1 in which the cavity is formed by a first member having a cylindrical recess and a second disc shaped plug member located within the cylindrical recess, the disc and the bottom of the recess forming the opposed walls.

3. A telephone handset as claimed in Claim 2 in which the disc shaped member is formed with a recess in one face, and is inserted so as to engage with the bottom of cylindrical recess in the first member, the recess in the disc shaped member forming the cavity.

4. A telephone handset as claimed in any of Claims 1 to 3 in which a moisture barrier comprising a plastics film is attached to the inside of a front cover of the microphone unit.

5. A telephone handset as claimed in Claim 4 in which the moisture barrier is attached to the front cover by means of an annular plastics foam member having a contact adhesive on each side.

6. A telephone handset as claimed in Claim 5 in which the moisture barrier is attached to the first member by a further annular plastics foam member having a contact adhesive on each side.

7. A telephone handset as claimed in Claim 5 or Claim 6 in which the and/or the further plastics foam member is formed from an open cell polyethylene foam.

8. A telephone handset including an electrostatic microphone unit substantially as described herein with reference to the accompanying drawings.

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